How to model Zac

Allow us to introduce Zac, a 3D cartoon character, who was mostly built with form-Z 2.9 features, primarily skins and metaformz.

In the following four pages we outline how we built Zac. However, our discussion does not attempt to give you precise numeric instructions, but rather visual hints about how you might model a similar 3D character. We do not mention any dimensions, because they are relative. They will depend on what scale you use. Our Zac is a giant. He is about 80 feet high! We built him at this size to be able to use the medium level defaults of form-Z.

As already mentioned, in building Zac, we mostly used skins and metaformz.

With skinning operations, drawing source and path shapes and placing them at the right positions is without question the most tedious task. While discussing in detail how the profile shapes we used were created would have been beyond the scope of this article, we show how our shapes look. We trust that they can be re-created with relative ease.

For the parts that are built with metaformz we do not give exact dimensions, but only mention the type of metaform we used. By their nature the metaformz are typically generated interactively through graphic input and in a "sketching" manner. This makes them more or less ideal for building 3D cartoons, such as Zac. To build parts analogous to ours, you will graphically generate the individual metaformz by visually inspecting their sizes, you will evaluate them, and you will then go back and adjust their sizes, parameters, and positions until you derive a satisfactory form. The chances are that your cartoon will in some ways look different than ours. So, you may actually model Zac's brother. Given the nature of the metaformz tools, this will be just fine and quite appropriate.

Modeling the upper torso

A "shirt" for the upper body of Zac is generated by a skinning along paths operation, using three sources and five paths, as shown.

We shall next add a collar to the shirt. This is done with another skin operation.

- Copy the top source shape and delete the "tooth" you added earlier, by deleting its segments.
- Working in front view, draw an open angular shape, as shown.
- Draw a similar but larger shape and position two copies of it at the ends of the circular shape, as shown.
- Execute a 1-source and 3-path skin. Note that the circular shape is the source and the angular shapes are the paths.

Next, we add arms. These are generated as objects of revolution.

- Working in front view, draw the two shown profiles. One is drawn about the X and the other about the Z axis.
- With the Object of Revolution tool, click on A, than on the X axis.
- Repeat the operation and click on B then on the Z axis.
- Make mirror copies of the two arm pieces and place them all on Zac's body.

Note that clean modeling usually dictates that parts of a model should not intersect. In this case, allowing the two arm pieces to intersect (and not unioning them) will allow us later to change their position, if desired.

To complete the upper part of the torso, we shall next model the hands. We actually model one hand using metaformz, more precisely stretched balls. We then make a copy for the second hand.

- In the Metaball Type dialog, select Stretched Ball and with the Create Metaballs tool draw four metaballs, for the palm. Then draw three metaballs for the thumb and five metaballs for each of the other fingers.
- Pre-select all the metaballs and use the Group tool to group them. This causes them to be evaluated.
- To next add the forearm, draw a line that extends from the hand and with the Derive/Edit tool click on it. When the Metaformz Parameters dialog is invoked, select Conic Tube.
- Finally, include the conic tube into the group to evaluate the hand with the forearm.

As is typical with skinning, the hardest part is drawing and positioning the profile shapes. Generally, there are different ways to do this. Use one that is most convenient to you. We first drew two paths working in a front view, and derived the others from them. We then drew a source shape and made two more scaled copies. Note that the sources are derived from an ellipse to which a "tooth" is added, using a 2D Union operation.
Modeling the lower torso

The lower part of Zac's body consists of a pair of pants and boots. The former will be modeled with metaballs. The latter with skinning.

• Working in front view, draw two 2-segment vector lines, in the same direction, as shown.
• In the Metaformz Parameters dialog select Conic Tube.
• With the Derive/Edit Metaformz tool click on each of the two lines and select different values for the first and second radii in the dialog that is invoked.
• In the Metaball Type dialog, select Stretched Ball and with the Create Metaballs tool draw three balls, at the upper part of the legs, as shown.

You now have five unevaluated metaformz. You will next group them in order to evaluate them.

• With the Pick tool pre-select the five metaformz and with the Group tool click anywhere in the graphics window. This evaluates the metaformz, as shown.

Modeling the spurs

Next, we shall model the spurs of the boots.

• Generate a cuboid, place it on the boot as shown, and derive the lines of intersection with the boot.
• Generate a c-mesh from the two circular shapes and then a parallel object.
• Draw a path line that attaches to the spur ring and sweep a rectangle, as shown.
• Derive a mirrored copy, then union both with the spur ring.
• Draw a patterned decagon in the shape of a star and derive a converged extrusion from it. Derive a mirrored copy and union the two together.
• Place the star in the groove of the spur. The result should now be as shown.

Modeling the boots

We shall next model the boots, using skinning.

• Working in orthographic views, draw three source and four path profiles, roughly as shown.
• In the Skin Options dialog select the proper options, including Close At Ends.
• With the Skin tool click on the sources and paths.
• In front view, draw a line for cutting the groove of the sole of the boot.
• Trim & Stitch the boot with the line.
• From the two faces at the bottom of the boot, derive two surface objects, then scale them up a bit. Then extrude them by a small height to add a sole to the bottom of the boot.
• Next delete the top face of the boot by applying a topological deletion with the Delete tool.

Your boot at this point should be as shown. You still need to add a spur, which you will do next.

Modeling the spurs

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• Draw a path line that attaches to the spur ring and sweep a rectangle, as shown.
• Derive a mirrored copy, then union both with the spur ring.
• Draw a patterned decagon in the shape of a star and derive a converged extrusion from it. Derive a mirrored copy and union the two together.
• Place the star in the groove of the spur. The result should now be as shown.
Modeling Zac’s head

Zac’s head will be modeled with metaformz of the type stretched metaballs.

• Working in whatever view is convenient (top, front, right, etc.) or even in tile windows, start by generating four stretched metaballs, roughly as shown, and use the Group tool to group them. As soon as you do they are evaluated into a shape that should be roughly as the one we show.

• Generate four more metaballs, two for the eyes and two for the ears. Place them in the head group, which is re-evaluated.

• Add one more metaball with a negative Weight. This is the mouth.

• Add a tube metaform for the neck. This is done by drawing a line where the neck should be and generating a tube by clicking on the line with the Derive/Edit Metaformz tool.

• Place the mouth and the neck into the head group and the whole head is re-evaluated, as shown.

You will now add a mustache and eyebrows.

• Generate nine stretched metaballs, as shown. Group them to evaluate them. This is the mustache. Place it where appropriate.

• Make two smaller and mirrored copies and place them as eyebrows.

Next you will make and add some hair.

• Create a revolved sphere the size of the head and position it roughly as shown.

• Using snap to point, draw vector lines going from the front of the head to the back. Only half of the head needs to be covered. The other half is generated by copying and mirroring.

• With the Derive/Edit Metaformz tool click on each of the lines you just generated to create chains of metaballs, covering the head.

• Group all these metaballs to evaluate them.

The result should be roughly as we show.

Modeling a cowboy hat

You may recall that we presented a tutorial for modeling a hat in the June 1995 issue of in•form•Z. There, it was done using c-meshes. Here we shall do a hat using the new Skin tool.

• Draw four circular shapes to be used as sources. Also draw eight open shapes to be used as paths.

Note that the circular source shapes are not flat. You generate such shapes as c-curves. You first draw a 6-8 sided polygon, then move some of its points up or down, and then use it as a control line to generate a c-curve. If you generate a tangent type of a quick curve, the points on your control shape will retain their original positions, which is useful if you have already placed them relative to your paths.

Also note that the hat can even be created with just one source and four paths. However, using more profile shapes allows you to introduce some additional variations to the form of the hat. For example, while the eight paths are initially copies of the same line, local variations are introduced to produce a shape which is not uniformly smooth.

• After setting the desired parameters in the Skin Options dialog, with the Skin tool select the sources and the paths. A hat is generated similar to the one we show.

One of the options in the Skin Options dialog you probably have selected is Close At Ends. This is useful for closing the top of your hat. But it also closes the lower end of the hat, which is not desirable. Use the Delete tool to eliminate the latter face, using topological deletion.

You next want to make a ribbon for the hat. You do this by deriving lines of intersection between the hat and two surfaces, positioned where the ribbon should be. You slightly scale these closed lines up and then use them to derive a c-mesh, which is the ribbon. Note that this is similar to the technique you used to derive the spur’s ring from the boots.

To complete the head assembly, you also need to make a bandanna for Zac’s neck.

• Working on top view, draw an ellipse, slightly larger than Zac’s neck. Then derive from it a 3D enclosure with open top and bottom.

• Working in side view draw a curved line that intersects the 3D enclosure in two places, roughly as shown.

• Use the Trim & Stitch tool to cut away the lower part of your cylindrical enclosure.

• Create a small revolved sphere and scale it to give it an ellipsoid shape. This is the knot of the bandanna.

• In the top view, draw a 2D vector and sweep a rectangle along it, while you apply a scale in both the X and Y directions. This is the end of your bandanna. Make one more copy and place it appropriately.

• Union the four pieces together and place the resulting object (bandanna) around Zac’s neck.
Modeling a guitar

When Zac isn’t arresting bad guys, he likes to play the guitar. So, we shall make one for him. The parts of the guitar will be identified as shown.

• Draw the shape of the body of the guitar. Because it is symmetrical, you can draw half of it, then copy-reflect it and join the pieces.
• From the 2D shape, generate a 3D enclosure with closed top and bottom.
• Insert a circular hole through the top of the guitar, as shown.

Next, we shall use the skinning operation to model the neck and head of the guitar in one piece. Four sources and four paths will be used, as shown.

• Apply Skin Along Paths By Current Position with Close At Ends and Insert New Points selected.

Next, you will model the frets of the guitar.

• Working in top view, draw 16 parallel lines corresponding to the frets of the guitar. Then extrude them to derive surface objects (turn on the Make Surface Object From Open Source Shape option in the Extrusion Options dialog).
• Move them into place so that they intersect the neck slightly at the top, and derive their lines of intersection with the neck.
• Draw a little rectangle and sweep it along all the fret lines to turn them into solid pieces. You will have to set the Status Of Objects parameter to Keep to be able to use the rectangle as a source shape each time.

You will next attach the neck piece to the body by cutting it so that it fits nicely on it.

• Triangulate the neck piece to make all its faces planar.
• Place it at one end, along the axis of the body of the guitar, as shown.
• Apply a Boolean Difference to cut away from the neck the part of the body that overlaps it.

Because the guitar body is an enclosure with space in it, the operation produces two volumes, one of which is inside the guitar. Even though it is not visible, use the Delete tool to delete it.

We shall next model the guitar bridge.

• With the Extrusion modifier active and a relatively small height selected in the Heights menu, draw a shape, roughly as shown.
• Insert a segment on the top face, from one corner point to the other, as shown.
• Working in a 3D view, with Topological level set to Segment, the XY reference plane active, and the Perpendicular switch on, move the segment you inserted earlier up by a bit.
• Round the top segments, as shown.
• Draw the shown peg shape and revolve it about a line. Then make six copies and place them on the bridge, evenly arranged.
• Finally take the complete bridge assembly and place it on the guitar body, as shown.

You will next create a guitar tuner.

• Generate the assembly of the four simple solids shown on the left. Union them all together, except for the cylinder at the top.
• Place three copies along each side of the guitar head. Slightly rotate the tuning pegs so that they are perpendicular to the top surface of the head, as shown.

Finally, you will generate the strings of the guitar. You will first draw lines corresponding to the axes of the strings. You will then sweep a very small source shape along them.

• With Snap to Point on, draw open lines corresponding to the six strings of the guitar. You draw each string by snapping to three key points.
• Draw a small hexagon and sweep it along each of the string lines.

Zac’s guitar is now complete. Position it on his belly, adjust his hands and arms to hold it properly and let him play a tune for you!